Citation:

Vioque J, Weinbrenner T, Castello A, Asensio L, Garcia de la Hera M. Intake of fruits and vegetables in relation to 10-year weight gain among Spanish adults. *Obesity (Silver Spring)*. 2008;16:664-670.

PubMed ID: 18239583

Study Design:

Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

The purpose of this study was to investigate the association between the intake of fruits and vegetables and the weight gain over a 10-year period in an adult Mediterranean population.

Inclusion Criteria:

The study included subjects selected from a 1994 health and nutrition survey who were from two well-defined areas in the provinces of Valencia and Alicante, Spain.

Exclusion Criteria:

Women who were pregnant at baseline in 1994 or at the end of follow-up.

Description of Study Protocol:

Recruitment: Recruitment was conducted via letter of invitation and telephone contacts to subjects from the 1994 health and nutrition survey.

Design: Cohort Study

Blinding used (if applicable): Not applicable

Intervention (if applicable): Not applicable

Statistical Analysis:

- Logistic regression models were used to assess the relation between both the intake of fruits and vegetables as two independent variables and the combination of fruit plus vegetables and the risk of gaining weight.

- Odds ratios and 95% confidence intervals were calculated with the lowest quartile of consumption as the reference category.
- Unpaired Student's *t*-tests, one factor ANOVA, and the Bonferroni post hoc test for means comparison of continuous variables by quartiles of fruit and vegetable consumption were used.
- x^2-tests were used for categorical variables.
- Paired *t*-tests were performed for comparison of results from 1994 and 2004
- All tests were two-sided and based on a 5% level of significance

Data Collection Summary:

Timing of Measurements: Baseline information for analysis was collected in 1994; new information was collected in 2004.

Dependent Variables

- Weight measured in kilograms and weight gain calculated as the difference between the two weight measurements (1994 and 2004) with the outcome variable defined as weight gain ≥ 3.41 kg over the 10 year follow-up period, based on the mean weight gain of men and women combined.

Independent Variables

- From a Food Frequency Questionnaire, average daily intakes for each of 10 fruit items (orange; apple; peach, nectarine, or apricot; watermelon, or melon; grapes; cherry; strawberry; fig; banana; olives) and 12 vegetable items (garlic; eggplant, zucchini, or cucumber; onion; mushrooms; cabbage; spinach; asparagus; green, red, yellow pepper; tomato; lettuce; carrot; legumes) was summed to compute subject's total fruit and vegetable intake. The Food Frequency Questionaire was a modified version of the Harvard questionnaire, and was validated for use among adult people in Valencia.

Control Variables

- Sex
- Age
- Educational level
- BMI
- Smoking habit
- Participation in regular activity programs
- TV watching
- Presence of disease
- Hours slept per day
- Total energy
- Energy-adjusted intakes of protein, saturated fat, monounsaturated fat, polyunsaturated fat, fiber, caffeine, and alcohol
- Height (for participants younger than 18 at the beginning of the study who had not reached their final height)

Description of Actual Data Sample:

Initial N: 206 (89 men and 117 women)

Attrition (final N): 206

Age: ≥ 15 years

Ethnicity: Spanish

Other relevant demographics: None reported

Anthropometrics: In general, the final participant sample (n= 206) presented characteristics similar to those of the initial random sample (n = 1,799) that was representative of the general adult population of Valencia in 1994.

Location: Provinces of Valencia and Alicante, Spain

Summary of Results:

Key Findings:

- Characteristics of participants between the follow-up study compared to the whole random sample participating in the nutritional survey were similar, except that physical activity was more frequent in the follow-up group.
- With increasing fruit and vegetable consumption, participants were significantly older (*P* for trend < 0.0001) and slept fewer hours per day (*P* for trend = 0.028). The 10 yr weight gain was significantly lower with increasing quartile of fruit and vegetable intake, (*P* for trend 0.0001).
- There was an inverse association between the intake of fruits and vegetables in 1994 and the risk of weight gain (≥ 3.41 kg) over a 10 yr period after adjustment for potential confounding factors.
- Compared to participants in the lowest quartile of fruit consumption (<149 g/day), participants in the third quartile (249-386 g/day) reduced their risk of gaining >3.41 kg by 69% (OR=0.31, 95% CI, 0.11-0.85; *P* for trend=0.044).
- Concerning vegetable intake, the risk of weight gain was lowest in participants of the fourth quartile (333 g/day), which had an 82% reduced risk of gaining ≥ 3.41 kg over the 10 yr period (OR=0.18, 95% CI, 0.05-0.66; *P* for trend= 0.017)
- When fruits and vegetables were combined, the risk of weight gain decreased across quartiles, with the lowest risk among those in the fourth quartile (OR=0.22, 95% CI,0.06-0.81; *P* for trend= 0.022)

Author Conclusion:

In conclusion, we found that increased fruit and vegetable intake was associated with significantly lower risk of a medium weight gain (>3.41 kg) over 10 years among adults of a Spanish Mediterranean population. Dietary strategies to increase fruit and vegetable intake to prevent and control overweight and obesity should be promoted more vigorously.

Reviewer Comments:

- *Fruit and vegetable intakes were assessed at baseline and changes in intake over time may have influenced weight gain outcome.*
- *The subjects were selected from a randomized representative sample of a previous study. Although the current study's sample showed similar characteristics in potential confounding factors (except physical activity), it was not a randomly selected study sample and therefore, may not be generalizable to the broader population.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	???
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
3.	**Were study groups comparable?**	N/A

3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	N/A
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A

6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	???
7.1.	Were primary and secondary endpoints described and relevant to the question?	???
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	???
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	N/A
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes

	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	Yes